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TECHNICAL REPORT

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THE RECOVERY OF WATERFOWL FEATHERS AND DOWN
FROM USED SLEEPING BAGS

by

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FOREWORD

This report describes a project carried out by the U. S. Army Natick Laboratories to determine the feasibility of reclaiming the down and feathers from used sleeping bags. The study had the dual objective of determining whether the waterfowl down and feathers in salvaged bags were usable and what their quality would be, and second, the economics of their recovery for reuse.

On the one hand there is a constant concern about the available supply of filling materials for sleeping bags since this is largely an imported material and anything that can be done to utilize available supplies would be advantageous. In addition, if such an available asset could be recovered economically, a plan should be available for such recovery, rather than to dispose of salvaged sleeping bags on a basis of a very low return and then proceed to buy new materials in the market. This study has clarified the issues involved in both of these points and provides a specific recommendation for a much more careful classification and repair of items marked for salvage.

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ABSTRACT

A study was made to determine the feasibility of recovering the waterfowl feathers and down from used military sleeping bags. Analysis of the recovered feathers and down indicated that while some damage occurred during use, all of this material could be reused if mixed with new stock of proper quality to bring the filling power of the final mixture up to the specification level of 6.0 centimeters. Accordingly, salvaged sleeping bags represent a source of feathers and down for use in new sleeping bags when and if a shortage of filling materials occurs.

The recovery of feathers from used sleeping bags is economical in that a net saving to the Government will be achieved if such a recovery of filling material is undertaken. Since most of the sleeping bags in the military supply system will ultimately be turned in for salvage, a plan is recommended whereby all sleeping bags are turned in for examination and repair and, if the circumstances warrant it, the bags which are definitely nonrepairable are marked for salvage of the filling materials. As indicated in this study, however, the greatest savings to the Government would accrue from a careful examination of salvaged bags and an adequate repair program. It is evident that many sleeping bags now marked for salvage could easily be repaired and returned to the supply system. A recent study showed that 57% of the bags classified for salvage were economically repairable. A new repair manual, which permits the use of iron-on patches in place of attempting to make repairs by sewing, greatly simplifies the repair procedure and should make it easier to salvage many bags which otherwise would have been discarded.

THE RECOVERY OF WATERFOWL FEATHERS AND DOWN
FROM USED SLEEPING BAGS

1. Introduction

a. Sources of Filling Material

Much of the production of waterfowl feathers and down, of the quality required for military sleeping bags, originates in Eastern Europe, the Soviet Union and China. As a result, the availability of this material has been considerably reduced in times of emergency. During World War II, the shortage of waterfowl feathers and down became so acute that the U. S. Government was compelled to freeze all available stocks for military use. To insure adequate supplies for future use, waterfowl feathers and down were classified as critical materials in 1950 and stockpiled in large quantities. During the period 1962-68, large Government procurements of sleeping bags and the concurrent effort not to disrupt domestic markets resulted in large quantities of the stockpiled material being used. Consequently, the amount of waterfowl feathers and down in the stockpile was reduced to a level where it became necessary to purchase this material on the open market.

As a result, the Defense Supply Agency Headquarters became concerned over the ability of the military services to obtain sufficient quantities of waterfowl feathers and down to meet future requirements likely to develop in an emergency. It was requested that an analysis be made of the military performance characteristic trade-offs that would have to be accepted for bags filled with potential filling material candidates other than waterfowl down and feathers. As a result of this request, two studies were initiated at the U. S. Army Natick Laboratories (NLABS), one to develop a substitute filling material, and a second to determine the possibility of recovering the filling material from sleeping bags declared unrepairable. This report is concerned with the latter study.

b. Types of Sleeping Bags

The standard military sleeping bag (M-1949) (MIL-S-830) used since World War II is a mummy-shaped bag filled with a mixture of waterfowl feathers and down. There are two types -- Mountain and Arctic -- both available in either regular or large size. The Arctic bag is used in extremely cold weather as an outer shell over the Mountain bag. The Arctic and Mountain bags are identical in construction, differing only in size and the amount of filling material. The amount of filling material (feather and down mixture) in each bag is as follows:

Mountain - regular	oz. 49
Mountain - large	55
Arctic - regular	38
Arctic - large	44

c. Composition and Treatment of Filling Material

The Tan-O-Quil-QM process for treating feathers and down was developed by the U. S. Army Natick Laboratories (NLABS)*. This process was required for all feathers used in sleeping bags starting in 1962. Prior to 1962, the sleeping bag was filled with a mixture of 60% untreated waterfowl feathers and 40% untreated down. The treatment for down was first required in 1964. The requirements for Tan-O-Quil-QM treated waterfowl feathers and down and the mixture used in sleeping bags are specified in Military Specification MIL-F-43097.

In 1963, two procurements were made for a total of 177,000 sleeping bags containing 40% chicken feathers, and a 60% mixture of waterfowl feathers and down. From 1964 to June 1966, military sleeping bags were filled with a blend of 40% treated down and 60% treated waterfowl feathers with a minimum filling power of 6.0 centimeters. After that date, the requirement was for a blend of down and waterfowl feathers proportioned to give a filling power of 6.0 centimeters after laundering. The down content of these blends varied between 10% and 40%, averaging out at about 18%. Starting in 1963, waterfowl feathers and down from the Government stockpile were used as filling material. Some of this material did not meet the requirements of the specifications for composition. It is evident, therefore, that the filling material in sleeping bags turned in for salvage will vary greatly in composition and treatment.

d. New Repair Manual

A new Technical Manual, TM-10-8400-201-23, for classifying and repairing sleeping bags turned in for repair or salvage, was issued for use at all levels, and has been implemented. The new manual greatly simplifies the repair of sleeping bags since it allows the use of iron-on patches for repairing holes and tears. Previously, these bags had been mended by sewing on patches or by darning. While this manual should result in many more sleeping bags being repaired, many sleeping bags which are nonrepairable will still be disposed of through normal channels.

2. Reclamation Procedures

A specification (MIL-F-43572) was prepared by NLABS which contains the procedures for recovery and re-treatment of waterfowl feathers and down. A contract was awarded to a processor to recover the waterfowl feathers and down from 1,000 used sleeping bags following the procedures in this specification.

* U. S. Army Natick Laboratories Technical Report 69-37-CM (TS-159), August 1968, "Tan-O-Quil-QM Treatment for Feathers and Down" by George Cohen

MIL-F-43572 requires the feathers and down removed from the sleeping bags be dusted, fractionated to separate the feathers from the down, washed and treated by the Tan-O-Quil-QM method. Following the recommendation of the contractor, the requirement for dusting was waived as it was not deemed necessary in recovering used feathers and down and might cause excessive damage, resulting in loose fiber and damaged feathers.

A total of 1,000 sleeping bags were supplied to the contractor. A tabulation of the types of sleeping bags showed the following:

	<u>Percent</u>
Regular Size Mountain	57
Large Size Mountain	33
Arctic	10

No particular difficulty was encountered in carrying out the procedures outlined in MIL-F-43572. The removal of the feathers and down from the sleeping bags was the most time-consuming as it had to be done entirely by hand and required the services of two operators. The procedure for opening the sleeping bags and removing the feather and down mixture was as follows:

With the zipper closed, one man holds the bag at the top, while another tears off the entire zipper. The bag now opens into a flat sheet. A cut is made across the entire width at the top of the bag with a utility knife and the top layer of fabric is torn away from the bottom layer, releasing the feathers and down mixture. Since the feathers have a tendency to stick to the fabric, care must be taken that all sections are open. The feather and down mixture is removed by shaking.

3. Results

It had been anticipated that there might be some difficulty in separating the down from the feathers since Tan-O-Quil-QM treated feathers and down have a tendency to create static electricity, causing them to clump together. This was easily overcome, however, by spraying a fine mist of water into the separators. Instead of applying the Tan-O-Quil-QM treatment separately to the feathers and down, the contractor suggested that it be applied to the mixture removed from the bags. Two hundred fifty pounds of the mixture were treated in this manner.

A breakdown of the total amounts of feathers and down recovered from 1,000 sleeping bags is given in Table I.

TABLE I
AMOUNT OF WATERFOWL FEATHERS AND DOWN RECOVERED

	<u>(lb)</u>
Mixture removed from bag	2890
Down separated	983
Feathers separated	1907
After Tan-O-Quil-QM treatment	
Down	905
Feathers	1860

The analysis of the mixture of waterfowl feathers and down and the separated feathers and down is given in Tables III, IV and V. For ease of identification, Table II provides a tabulation of the materials analyzed.

TABLE II
 FILLING MATERIALS ANALYZED

NLABS Sample No.

- A69W - Mixture of feathers and down as removed from sleeping bags and washed
- A70W - Waterfowl feathers removed from sleeping bags and washed
- A71W - Down removed from sleeping bags and washed
- A72 - Mixture of feathers and down removed from sleeping bags, washed and Tan-O-Quil-QM treated
- A73 - Waterfowl feathers removed from sleeping bags washed and Tan-O-Quil-QM treated
- A74 - Down removed from sleeping bags, washed and Tan-O-Quil-QM treated

Despite the high damaged feather content of the recovered waterfowl feathers (Table III), the filling power is comparable to a better-than-average grade of duck feather. NLABS' experience with feathers of a comparable grade and high damaged feather content has shown that the

filling power requirement of 6.0 centimeters for the blend used to fill the sleeping bag could be met if 60% of these feathers are mixed with 40% of down having a filling power of 7.5 centimeters. Smaller amounts of down could be used if the recovered feathers were mixed with higher quality feathers. This has the advantage of raising the overall quality of the feathers and decreasing the amount of down required to make the blend. Another use for these feathers is in pillows, in which case the damaged feather content would not be serious as long as the filling power was satisfactory. The fact that the Tan-O-Quil-QM treatment did not increase the filling power is probably because many of these feathers, as indicated by the chrome content, had already been treated. The chromic oxide content of 0.16% indicates that about one-third of the feathers had previously been Tan-O-Quil-QM treated. Probably, the Tan-O-Quil-QM treatment should be modified for these feathers by reducing the amount of chemicals required.

TABLE III

ANALYSIS OF WATERFOWL FEATHERS

	<u>Washed, Untreated</u> (Sample No. A70W)	<u>Treated</u> (Sample No. A73)
Filling Power (cms)	4.8	4.4
pH	4.1	3.2
Oxygen No.	2.0	2.8
Chromic Oxide (%)	0.16	0.32
	<u>Composition - % by weight</u>	
Down	14.4	14.6
Waterfowl Feathers	51.0	65.0
Landfowl Feathers	6.3	2.5
Damaged Feathers	24.7	14.9
Quill Feathersq	1.0	1.3
Down Fiber	1.0	1.0
Feather Fiber	1.0	0.3
Landfowl Fiber	0.2	0.1
Residue	0.4	0.4

The analysis of the recovered down is given in Table IV. In composition, this material represents a fair-to-good grade of plumage comparable to commercial grades of down available on the market today. Its filling power of 5.9 centimeters, however, is low. The blend of waterfowl feathers and down used to fill sleeping bags must have a minimum filling power of 6.0 ± 0.2 centimeters which precludes the use of the recovered down unless it is mixed with waterfowl feathers with a minimum filling power of 6.0 centimeters. This is allowed under the applicable specification MIL-F-43097E, provided the down is Government Furnished Property (GFP), and has been done in the past with Government-furnished down of comparable quality. Because of the low filling power of the down, a blend for filling sleeping bags which would meet specification requirements of 6.0 centimeters, cannot be made using only the recovered feathers and down. Additional feathers or down with a higher filling power would have to be added.

Samples of the recovered waterfowl down and feathers were examined by two experts in this field. They both were of the opinion that the washed down (Sample A71W) represented a fair-to-good quality of commercially available down and could be reused without further treatment. As previously pointed out, however, the filling power was not high enough to permit its use in military sleeping bags unless additional higher quality down or feathers with a high filling power were used.

TABLE IV

ANALYSIS OF RECOVERED DOWN

	<u>Washed, Untreated</u> (Sample No. A71W)	<u>Treated</u> (Sample No. A74)
Filling Power (cms)	6.3	5.8
pH	4.4	3.3
Oxygen No.	2.4	2.8
Chromic Oxide (%)	0.16	0.34

Composition - % by weight

Down	73.2	71.9
Waterfowl Feathers	12.5	15.2
Landfowl Feathers	1.7	1.0
Damaged Feathers	3.5	2.7
Quill Feathers	--	--
Down Fiber	5.7	5.8
Feather Fiber	2.2	1.9
Landfowl Fiber	0.8	0.6
Residue	0.4	0.9

An analysis of the blend removed from the sleeping bags, untreated but washed (A69W), and after treatment (A72), is given in Table V. The filling power of 4.9 centimeters for the treated blend, which is well below the specification requirement of 6.0 centimeters, would preclude its use in this form unless additional down or feathers with higher filling power were added. It is evident from the chromic oxide content of the washed but untreated feathers and down mixture (A69W) that a quantity of the mixture had been Tan-O-Quil-QM treated. Eventually, it is anticipated that all of the sleeping bags turned in for salvage will contain treated feathers and down. There is a possibility that it then may not be necessary to re-treat the mixture which would result in a considerable reduction in the recovery cost since the fractionation and Tan-O-Quil-QM treatment would be eliminated. However, the filling power (4.8 centimeters) of the washed but untreated mixture recovered in this study (Sample A69W) which is well below the requirement of 6.0 centimeters, precludes its use in this manner unless additional feathers and/or down with a higher filling power are added.

TABLE V

ANALYSIS OF WATERFOWL FEATHER AND DOWN MIXTURE

	<u>Washed, Untreated</u> (Sample No. A69W)	<u>Treated</u> (Sample No. A72)
Filling Power (cms)	4.8	4.9
pH	4.1	3.1
Oxygen No.	1.6	2.8
Chromic Oxide (%)	0.19	0.35
	<u>Composition - % by weight</u>	
Down	34.6	9.0
Waterfowl Feathers	40.5	37.6
Landfowl Feathers	3.4	2.9
Damaged Feathers	18.0	15.1
Quill Feathers	0.7	2.2
Down Fiber	1.7	1.8
Feather Fiber	0.3	1.1
Residue	0.6	0.9
Landfowl Fiber	0.2	0.3

The contractor's estimated cost for recovering the filling material from 1,000 sleeping bags is given in Table VI.

TABLE VI

COST OF RECOVERING FILLING MATERIAL FROM 1,000 SLEEPING BAGS

Removing feathers and down from bags	\$ 500.00
Separating (fractionating) feathers from down	450.00
Washing and Tan-O-Quil-QM treatment	1200.00
Blending feathers and down	250.00
Storage, handling and packing	500.00
Shipping costs	100.00
Total cost:	<u>\$3000.00</u>

The estimated value of the recovered material and the net return to the Government are shown in Table VII.

TABLE VII

ESTIMATED REPLACEMENT VALUE OF RECOVERED WATERFOWL FEATHERS AND DOWN

905 pounds of down at \$4.50	\$4072.50
1,860 pounds of feathers at \$1.25	<u>2325.00</u>
Total:	\$6397.50
Recovery cost	3000.00
Resale value of bags at \$2.50 each	<u>2500.00</u>
Net return to the Government:	\$ 897.50

4. Summary and Conclusions

The results show that about 90% of the filling material (waterfowl feathers and down) in used, nonrepairable sleeping bags can be recovered using the procedures in MIL-F-43572. NLABS' experience with feathers of comparable quality indicates that while some damage has occurred to the feathers during use of the bags, the overall quality is such that the recovered feathers and down are definitely usable when used in a mixture with new feathers and down of proper quality.

The recovered down appears to be of good quality except for being lower in filling power than new down. To use this material in sleeping bags, however, it would have to be blended with waterfowl feathers with a filling power of 6.0 centimeters. This quality of feathers is now required in all contractor-furnished waterfowl feathers and down blends for filling sleeping bags. Blends, with a filling power suitable for filling military sleeping bags, consisting entirely of the recovered waterfowl feathers and down, cannot be made satisfactorily. Additional down and/or feathers of higher filling power must be added to raise the filling power of the blend.

It is reasonable to assume that eventually most of the sleeping bags in the military supply system will be turned in for salvage. The majority of the sleeping bags turned in for salvage and examined were four to 12 years old. During FY 67 and 68, approximately one million sleeping bags, containing in excess of three million pounds of waterfowl feathers and down were procured. The re-use of this quantity of material would substantially reduce the amount of waterfowl feathers and down procured from foreign sources. While the records are not immediately available, it is believed that the waterfowl feathers and down remaining in the stockpile are of high quality and would be suitable for mixing with this recovered feathers and down to increase their filling power. Use of the recovered feathers and down would therefore substantially extend the stockpiled material.

The greatest saving to the Government, however, would accrue by assuring that all used but repairable bags are repaired and returned to the supply system. A recent study showed that 57% of the sleeping bags classified for salvage were economically repairable. Each sleeping bag which is repaired and returned to the supply system replaces a new bag. Use of the new repair manual, which allows iron-on patches, should simplify the repair procedure and result in more bags being repaired and returned to the supply system.

5. Recommendations

The following recommendations are made:

a. The use of TM-10-8400-201-23 for classifying and repairing used sleeping bags be implemented as rapidly as possible at all levels.

b. A centralized program for the classification and repair of unserviceable sleeping bags be established.

6. Acknowledgments

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<p>A study was made to determine the feasibility of recovering waterfowl feathers and down from used military sleeping bags. Analysis of the recovered feathers and down indicated that while some damage occurred during use, all of this material could be reused if mixed with new stock of proper quality to bring the filling power of the final mixture up to the specification level of 6.0 centimeters. Accordingly, salvaged sleeping bags represent a source of feathers and down for use in new sleeping bags when and if a shortage of filling material occurs.</p> <p>The recovery of feathers from used sleeping bags is economical in that a net saving to the Government will be achieved if such a recovery of filling material is undertaken. Since most of the sleeping bags in the military supply system will ultimately be turned in for salvage, a plan is recommended whereby all sleeping bags are turned in for examination and repair and, if the circumstances warrant it, the bags which are definitely nonrepairable are marked for salvage of the filling materials. As indicated in this study, however, the greatest savings to the Government would accrue from a careful examination of salvaged bags and an adequate repair program. It is evident that many sleeping bags now marked for salvage could easily be repaired and returned to the supply system. A recent study showed that 57% of the bags classified for salvage were economically repairable. A new repair manual, which permits the use of iron-on patches in place of attempting to make repairs by sewing, greatly simplified the repair procedure and should make it easier to salvage many bags which otherwise would have been discarded.</p>		

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